

APPENDIX R – SUPPLEMENTAL SITE INVESTIGATION WORKPLAN SAMPLE

Supplemental Site Investigation Workplan

[Site Designation]
[Site Address or Major Cross Streets]
[City], California [Zip Code]
[Site Code]

Prepared for:
[School District]
[District Office Address]
[City], California [Zip Code]

Prepared by:
[Consultant Company]
[Office Address]
[City], California [Zip Code]

[Date of Report]

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EXECUTIVE SUMMARY

The executive summary should summarize the main information presented in the Supplemental Site Investigation Workplan. It should include, but not be limited to, the following information:

- Purpose of the Supplemental Site Investigation Workplan
 - Identification of areas of concern being addressed and description of additional investigation based on the findings of the Preliminary Environmental Assessment.
- School district
- Site designation consistent with information submitted to the California Department of Education
- Site location
 - Street address or nearest cross streets
 - City and county
- Site description
 - Size of the site (preferably in acres)
 - Current and historical business activity conducted on site
- Type of school site – proposed, expansion, or existing
- Type of school proposed – grade levels of students
- Number of classrooms and students
- Intended use of the site – whether all or a portion of the site will be used

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APPENDICES

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Appendix B	Responses to DTSC Comments
Appendix C	Quality Assurance Project Plan
Appendix D	Health and Safety Plan

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ABBREVIATIONS AND ACRONYMS

Abbreviation Description
or acronym

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1.0 INTRODUCTION

The introduction should introduce the site, present the organization of the report, and include the following information:

- School district
- Site designation consistent with information submitted to the California Department of Education
- Site location
 - Street address or nearest cross streets
 - City and county
- Type of school site – proposed, expansion, or existing
- Type of school proposed – grade levels of students
- Number of classrooms and students
- Intended use of the site – whether all or a portion of the site will be used
- Proposed disposition of existing structures
- Proposed source of potable and non-potable water supply

The introduction should also identify the areas of concern that lead to the recommendation for further action and the reason for preparing a Supplemental Site Investigation (SSI) Workplan which may include:

- A PEA Report was submitted for DTSC review and approval and DTSC provided a determination that a further action is required to address a release or threatened release of hazardous material or the presence of a naturally occurring hazardous material, which would pose a threat to public health or the environment under unrestricted land use. Provide the date of the determination letter and include a copy of the letter in Appendix A.

This section should briefly address the SSI scoping meeting, participants, and discussion.

1.1 PURPOSE

This section should state the purpose of the SSI Workplan, part of the third step of the environmental review process for school sites, with respect to areas of concern identified for the site. These objectives should include, at a minimum:

- Determine the horizontal and vertical extent of contamination encountered during the PEA.
- Evaluate potential threat(s) to public health and the environment posed by chemicals of concern.

- Evaluate whether remedial action is required.

This section may also include other objectives or reasons as requested by the school district.

1.2 SCOPE OF WORK

The scope of work should provide a detailed scope of services conducted for the PEA, including assumptions, limitations and exceptions, special terms and conditions, and user reliance. This section should list the DTSC requirements or guidance complied with to meet the objectives of the SSI Workplan.

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2.0 SITE DESCRIPTION

This section should include the following school site designation and location information:

- School site designation consistent with information submitted to CDE.
- Other site designations used historically.
- United States Environmental Protection Agency (U.S. EPA) identification number, if assigned.
- DTSC EnviroStor database number, if assigned.
- Street address or nearest cross streets, city or nearest community, county, state, zip code
- School district
- Size of the site (preferably in acres)
- Assessor's parcel number
- Township, range, section, and principal meridian
- Geographic coordinates (longitude and latitude)
- State Senate and Assembly districts

This section should also a summary of current and historical activities, and a brief summary of the environmental assessments or investigations leading up to the SSI. This section can reference the PEA Report for more details, but enough information should be provided to ascertain the areas of concern and associated chemicals of concern, update the conceptual site model, identify data gaps, and justify the sampling proposed.

3.0 AREAS OF CONCERN

This section should summarize the following findings of the PEA conducted to address RECs identified in the Phase I (or after review of information consistent with a Phase I):

- Nature and extent of contamination, determined thus far, based on sampling.
- Fate and transport based on the environmental migration screening evaluation.
- Human health risk based on the human health screening evaluation.

Based on these findings, the areas of concern (AOCs) and associated chemicals of concern should be identified. For each AOC, following information should be presented:

- Chemicals of concern
- Extent to which the AOC has been characterized horizontally and vertically
- Media impacted

4.0 ENVIRONMENTAL SETTING

As part of the Phase I (or review of information consistent with a Phase I), information should have been collected regarding the site's environmental characteristics. This section should include a summary of the following information:

- Topographic, geologic, and hydrogeologic features associated with the site and surrounding areas.
- Potential pathways (soil, groundwater, surface water, and air) of contaminant migration and environmental conditions which would influence the fate and transport of contaminants from the source of contamination through identified potential exposure pathways to the exposed individual or environmental receptor.

This section can reference the PEA Report for more details, but enough information should be provided to update the conceptual site model, identify data gaps, and justify the sampling proposed.

5.0 CONCEPTUAL SITE MODEL

The conceptual site model (CSM) from the PEA Report should be updated to include the results of the PEA investigation. The CSM should include a narrative and graphical description of site characteristics, and should provide a foundation for understanding a site. The CSM integrates the areas of concern and chemicals of potential concern with the environmental setting at the site. The CSM should identify potential contamination sources and link them to potential receptors through release mechanisms, potential pathways, and exposure routes. The CSM should incorporate all essential features of the topographic, geologic, and hydrogeologic systems at the site. The degree of detail and accuracy of the CSM will vary according to the site setting and contaminant type(s). For simpler sites, the CSM may only include a discussion of areas of concern, a figure showing potential exposure scenarios (Figure 5A) and a site plan. For more advanced sites (e.g., sites with NOA or impacts to groundwater), a more detailed CSM will be necessary and may also include figures such as groundwater flow maps, iso-concentration drawings, geologic cross-sections, and detailed geologic maps of the surface and subsurface. Examples of such figures are included in Figures 5B through 5D.

The CSM is an iterative process. The initial CSM is used to develop the Field Sampling Plan (FSP) which is designed to determine the source of contamination, evaluate the migration potential and assess the exposure potential. As data gaps are identified and additional data is collected, the CSM should be revised. The resulting final CSM should be detailed enough to meet the characterization objectives, and provide enough information to make appropriate regulatory decisions.

6.0 DATA GAPS

Based on the conceptual site model, data gaps should be identified. Data gaps are missing information necessary to form conclusions and recommendations for the site that will ultimately lead to a regulatory decision. These data gaps should be used to form the objectives for and direct sampling activities.

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7.0 FIELD SAMPLING PLAN

The Field Sampling Plan (FSP) is a critical component of the SSI Work Plan that is used to direct sampling activities in the field. The FSP should provide complete instructions to be followed in the field and should include the information indicated by the following subheadings.

7.1 SAMPLING OBJECTIVES

The sampling objectives should be developed based on the updated conceptual site model, identified data gaps, and data quality objectives (DQOs) process described in the *Guidance on Systematic Planning using the Data Quality Objectives Process (QA/G-4)* (U.S. EPA 2006a). The DQO process is used to ensure that the data collected is of sufficient quality and quantity to support defensible decision-making while utilizing resources effectively. This process will result in a data collection design or sampling strategy that meets the sampling objectives. The DQO process includes the following steps:

1. State the problem – Concisely describe the problem to be studied.
2. Identify the decision – Identify the questions the investigation will attempt to resolve and actions that may result.
3. Identify inputs to the decision – Identify the information needed and the measurements needed to resolve the decision statement. Inputs to the decision should be based on the areas of concern and associated chemicals of concern. These inputs should include the sampling media, concentration of target analytes on site, appropriate analytical methods, and screening levels derived from a human health screening evaluation and an environmental migration screening evaluation.
4. Define the study boundaries – Specify the time periods and spatial area to which decisions will apply. Determine when and where the data should be collected. This step includes the following activities:
 - a. Specify characteristics that define the population of interest.
 - b. Define the spatial boundary of the decision statement. The spatial boundary typically coincides with site boundaries and may be defined by depth. Then, the population should be divided into strata that generally coincide with the area associated with area of concern.
 - c. Determine the temporal boundary of the problem. The timeframe to which the decision applies can be correlated to the human health screening evaluation (exposure duration) and the environmental migration screening evaluation. Select the most appropriate time frame to collect data considering such factors as weather, temperature, humidity, precipitation, sunlight, and wind. For example, soil gas samples are affected by

precipitation and methane concentrations in soil are affected by soil moisture.

- d. Define the scale of decision making. Generally, decisions should be made based on areas associated with recognized environmental conditions.
 - e. Identify practical constraints on data collection such as site access issues or weather conditions.
5. Develop a decision rule – Define the parameter of interest, specify the action level, and integrate the previous steps into a single statement that describes the logical basis for choosing among alternative actions.
 6. Specify tolerable limits on decision errors – Define the tolerable decision error rates based on consideration of the consequences of making an incorrect decision.
 7. Optimize the design – evaluate information from the previous steps and general alternative data collection designs. Choose the most resource-effective design that meets all DQOs.

7.2 SAMPLING APPROACH

This section should describe sampling strategy to be used, justification for use, and any regulations or guidance followed. The following sample types are typically used on school sites:

- Judgmental: Samples are collected from the portion(s) of the site most likely to be contaminated or collected to evaluate the extent or patterns of the onsite contaminant(s).
- Random: Random sampling involves collection of samples in a nonsystematic fashion from the entire site or a specific portion of the site.
- Systematic: Systematic sampling involves collection of samples based on a grid or a pattern which has been previously established.

A combination of these or other sample types may be the best approach depending on type of contamination, size of the site, and level of information desired.

This section should identify the media to be sampled based on the DQOs for the investigation and may include the following:

- Geophysical survey
- Soil gas
- Soil matrix
- Groundwater
- Surface water
- Sediment
- Air
- Background

General guidelines for field sampling plans are provided. These general guidelines are followed by additional information that should be included in media-specific field

sampling plans. The FSP may be organized in any manner that best suits the site as long as it provides clear and complete instruction to be followed in the field including:

- Sampling locations and rationale
- Sample collection
- Sample analyses
- Investigation derived waste management

Media-specific information to be included in the FSP (Section 7.7) follows the general outline of the FSP (Sections 7.1 through 7.6),

7.3 SAMPLING LOCATIONS AND RATIONALE

This section should present the sampling locations and rationale. Sampling locations should be presented on a site plan. The site plan should be of sufficient detail to clearly show sampling locations relative to the associated recognized environmental condition. Sampling locations, depths, designation, rationale, and analyses should be identified in Table 1.

7.4 SAMPLE COLLECTION

This section of the report should describe the step-by-step procedures of how each sample will be collected. The procedures should be sufficiently detailed for field personnel to implement. The description should demonstrate that the data gathered will meet the sampling objectives.

7.4.1 Sampling Equipment and Procedures

This section should describe all equipment and procedures used to obtain samples.

7.4.1.1 DECONTAMINATION

Removing or neutralizing contaminants from equipment minimizes the likelihood of sample cross-contamination, reduces or eliminates transfer of contaminants to clean areas, and prevents the mixing of incompatible substances. This section should describe decontamination procedures that will be used for personnel and equipment.

Non-dedicated equipment should be decontaminated before and/or after each sample collection. The equipment should be washed with a non-phosphate detergent, rinsed in potable water, and double rinsed with distilled water. A description of the specific methodologies followed to maximize proper equipment decontamination and with consideration for collection of equipment rinse samples should be provided.

Decontamination stations should be set up before any personnel or equipment enters the areas of potential exposure. The description of decontamination should include information, such as:

- Number, location, and layout of decontamination stations
- Decontamination equipment

- Decontamination methods.

Using plastic sheeting or other barrier beneath decontamination stations will help prevent contamination from spreading.

7.4.1.2 PREPARATION

A description of the methods used to homogenize, split, and composite samples should be provided.

7.4.2 Containers and Preservation

Requirements for analytical methods, detection limits, sample containers, volumes, preservatives, and holding times by parameter per matrix should be presented in Table 2. The laboratory should provide sample containers prior to sampling events. All supplies should be certified clean or new by the suppliers, inspected by the project team prior to their use, and monitored by the employed laboratory through the use of standards and blank samples as appropriate. Appropriate supplies, e.g., special water sample bottle for paraquat analysis, should be clearly specified. The description for sample collection and analysis contained in the methods should be used as a guideline for establishing the acceptance criteria for supplies. The containers should be pre-cleaned to meet U.S. EPA standards and should not be rinsed in the field prior to sample collection. Prior to delivery of sampling containers, the laboratory should add preservatives required in the containers for aqueous samples.

Specific containers are required for some tests. Generally, samples for organic analysis are collected in glass, brass, stainless steel, or acetate containers. These containers should be free of organic plasticizers. Certain organics which are sensitive to light and decompose easily are collected in amber glass containers if glass jars are to be used. Samples for inorganic analysis are generally collected in plastic, glass, brass, stainless steel, or acetate.

Methods of sample preservation are relatively limited and are generally intended to retard biological action and inhibit microbial degradation, retard hydrolysis, and reduce absorption effects. Preservation methods are generally limited to pH control, chemical addition, refrigeration (4 degrees Celsius), and freezing.

Holding time is the maximum time samples may be held prior to analysis and still be considered valid. It starts at the time of sample collection. Holding time for each analytical method and analyte should be provided and any holding time shorter than 30 days be clearly specified. If holding times are exceeded, and the analyses are performed, the associated results should be qualified.

7.4.2.1 SOIL

When organics are the analytes of interest, glass jars with Teflon-lined caps or brass, stainless steel, or acetate sleeves with Teflon sheets covering the end of the sleeve

followed by a snug tight plastic cap should be used. The container should be completely filled to minimize headspace in the container.

When VOCs are the analytes of interest, U.S. EPA Method 5035A should be used to collect and preserve the samples. A minimum of three sub-cores per sample should be collected for each discrete sample with one sample in a batch of twenty samples or less should have a minimum of five sub-cores collected for QC purposes. The weight of all sub-cores should be described in the sampling plan. It is recommended to find out from laboratory the weights to be used for the sub-core sampling. Indicate in the sampling plan whether field preservation will be implemented.

When inorganics are the analytes of interest, polyethylene containers, plastic bags (e.g Ziploc or similar), glass jars, brass, stainless steel, or acetate sleeves should be used. Samples collected for hexavalent chromium should not be collected in stainless steel sleeves and samples collected for organic lead should be managed as an organic analyte.

It is recommended to store each sample within a plastic bags (e.g Ziploc or similar) to prevent moisture seeping into the sample, the sample label being damaged, or cross-contamination occurring during storage and transportation. It is also recommended to identify the end of the sleeve that the laboratory should use for the analysis.

Preservation of soil samples is generally limited to refrigeration at 4 degrees Celsius or freezing the samples. Samples collected for VOCs by U.S. EPA Method 5035A and are preserved in the field should use two pre-tarred vials of analysis (VOAs) with sodium bisulfate and one pre-tarred VOA with methanol for each discrete sample. It is recommended to use blue ice combined with ice to preserve the samples in the field. The blue ice will keep the ice from melting quickly and maintain the desired temperature. Note that blue ice by itself will not maintain the desired temperature for an extended period.

7.4.2.2 WATER

When organics are the analytes of interest, glass bottles with Teflon-lined caps should be used. VOAs should be used for VOC analysis and should be filled with no headspace or air bubbles. To check for air bubbles, turn the VOA upside down and tap on the side, if there are air bubbles, reopen the lid and add additional sample, and recheck. Amber bottles should be used for photo-sensitive analytes.

Water samples generally have acidification preservation along with temperature preservation. VOCs should be preserved with hydrochloric acid (HCl) or sodium bisulfate (NaHSO₄) and metals should be preserved with nitric acid (HNO₃). In both instances, the pH should be less than 2. For all of the various methods and analytes, it is recommended to check with each method in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, U.S. EPA Publication SW-846, (U.S. EPA 1986) to confirm the preservation and quantity needed required by the method.

7.4.2.3 SOIL GAS

Refer to the *Advisory – Active Soil Gas Investigations* (DTSC/RWQCB 2003) for information on sample containers, holding times, and analytical methods.

7.4.3 Packaging and Shipment

7.4.3.1 SAMPLE LABELING

A label completed in indelible ink should be affixed to each sample container for proper identification in the field and for tracking in the laboratory. Sample labels can be used to secure the cap on a sample container or jar. The sample labels should include the following information:

- Field ID name or number
- Collection date and time
- Project name or number
- Collector name or initials
- Preservation, if any

7.4.3.2 CUSTODY SEALS

Custody seals are strips of printed tape that are used to demonstrate that no tampering has occurred to the sample. Seals can be placed over container caps, bags containing samples, or sample transport containers (coolers). They may also be used to seal sampling equipment at the site. Custody seals are recommended for samples where the data may be under litigation.

7.4.3.3 SAMPLE PACKAGING AND SHIPMENT

Samples are packaged for two broad classes of samples, environmental samples and hazardous samples. Air, soil, and water samples are usually considered environmental samples depending on the site. Unless known to be non-hazardous, all samples from drums, tanks, and process streams are considered hazardous samples requiring compliance with Code of Federal Regulations, Title 49, Parts 171 through 179. Following collection and labeling, samples should be immediately placed in a sample cooler for temporary storage. The following protocol should be followed for sample packaging:

- Sample containers should be placed in clear, plastic, leak-resistant bags prior to placement in the ice chest. Sample sleeve liner caps or container screw caps should be checked for tightness and sealed prior to placing the sample in the bag. A self-adhesive custody seal should be placed about the end of each plastic bag. A copy of the seal should be included in the FSP. All custody seals should be signed and dated.
- Samples to be shipped should be placed in a study cooler lined with a large plastic trash bag prior to placing samples therein. The bottom of the cooler should be lined with bubble wrap. Glass sample containers should be wrapped in bubble wrap. Empty space in the cooler should be filled with bubble wrap or Styrofoam SSInuts to

prevent movement and breakage of samples during shipment. Vermiculite should also be placed in the cooler to absorb spills.

- Ice or “Blue Ice” packs should be placed in double leak-resistant plastic bags and included in the coolers to keep samples at a chilled temperature of 4°C plus or minus 2°C during transport to the analytical laboratory. When ice is used, the drain plug of the cooler should be secured with glass fiber tape to prevent melting ice from leaking out of the cooler.
- The chain-of-custody form should be placed in a water-resistant plastic bag and taped on the inside of the lid of the cooler.
- Strapping and/or evidence tape (or equivalent) should be placed around each cooler to secure the lid prior to transport to the laboratory.
- A self-adhesive custody seal should be placed across the front closure of the cooler any time it is not in someone’s possession or view before shipping. Just prior to shipping, custody seals should be affixed to the front, right, and back of the cooler. All custody seals should be signed and dated.
- To check the potential effects of sample transportation and handling on data quality, a temperature blank should be enclosed in each sample-shipping container when samples requiring preservation by chilling are transported. The temperature blank should be comprised of a 40-mL vial filled with distilled or potable tap water and clearly marked to indicate its purpose to the laboratory. The temperature blank should be placed next to the investigation samples during packaging. The temperature of the water in the temperature blanks should be recorded upon arrival at the laboratory. The target sample temperature is 4°C plus or minus 2°C.
- Every effort should be made to transport the samples to the analytical laboratory at the end of each sampling day. However, for sampling days that continue after operating hours of the laboratory, the samples should be stored overnight in a secured location (e.g., in a locked office) under appropriate chain-of-custody procedures, and the samples should be shipped to the laboratory the next business day. Prior to overnight storage, the cooler(s) should be restocked with new ice or blue ice to maintain the samples in a chilled state of 4°C plus or minus 2°C. The sample collector should check the temperature blank inside each cooler at the beginning of the evening and in the morning and the temperature readings should be recorded in the field logbook. Alternately, samples may be shipped to the laboratory by overnight courier under chain-of-custody requirements specified herein.

7.4.4 Documentation

Sample documentation includes field logs, boring logs, chain-of-custody, photographs, and if appropriate, field analysis documentation.

7.4.4.1 FIELD LOGS

Field logbooks should be maintained during field activities to document where, when, how, and from whom any vital project information was obtained. Logbook entries should be complete and accurate enough to permit reconstruction of field activities. Logbooks should be bound with consecutively numbered pages. Each page should be dated and the time of entry noted in military time. All entries should be legible, written in ink, and signed by the individual making the entries. Language should be factual,

objective, and free of personal opinions or other terminology, which might prove inappropriate. If an error is made, corrections should be made by crossing a line through the error and entering the correct information. Corrections should be dated and initialed. No entries should be obliterated or rendered unreadable.

Entries in the field logbook should include at a minimum the following for each day:

- Site name and address
- Recorder's name
- Team members, subcontractors, and their responsibilities
- Time of site arrival/entry on site and time of site departure
- Other personnel onsite
- Weather conditions including air temperature, precipitation or high wind conditions
- A summary of any onsite meetings
- Deviations from sampling plans, or site safety plans
- Changes in personnel and responsibilities as well as reasons for the changes
- Levels of safety protection
- Calibration readings for any equipment used and equipment model and serial number.
- Field observations, field monitoring readings (e.g., PID) and details important to analysis and/or integrity of the samples

At a minimum, the following information should be recorded during the collection of each sample:

- Sample identification number
- Sample location and description
- Site sketch showing sample location and measured distances to physical reference points
- Sampler name(s)
- Date and time of sample collection
- Designation of sample as composite or grab
- Type of sample (i.e., matrix)
- Type of preservation
- Type of sampling equipment used
- Lot numbers of vendor-supplied sample containers or specialty-grade water
- Field observations and details important to analysis or integrity of samples (e.g., heavy rains, odors, colors)
- Instrument readings (e.g., PID)
- Chain-of-custody form numbers
- Shipping arrangements (by overnight courier delivery company including air bill number, or laboratory pickup including name of personnel and time of departure)
- Recipient laboratory(ies)

The data from field screening instruments should be documented in a field log book. The following information should be documented:

- Data from the measurement
- Method of collecting sample (e.g., directly from probe, soil cutting vapors in a ziplock baggie)
- Concentration of background sample and location of sample
- Instrument span setting
- Calibration gas type and concentration

Documentation of calibration concentrations. It is recommended to run an end of the day calibration to confirm the instrument's calibration has not shifted.

7.4.4.2 BORING LOGS

Lithologic logs for any borings (e.g., soil matrix borings deeper than 5 feet BGS, continuously cored borings) should be described in the field by a person who is under the direct supervision of a California Professional Civil Engineer (PE) or Geologist (PG) in accordance with the Business and Professions Code. The lithologic logs should be reviewed, signed and stamped by a California Registered Professional (e.g., a geologist, a civil engineer). Concise drilling logs and field records should be prepared detailing at least the following information:

- The lithology (geologic or soil classification) of each geologic and soil unit in the unsaturated and saturated zones, including the confining layer. Soils should be described using the Unified Soil Classification System (USCS) or United States Department of Agriculture (USDA) soil classification system (accompanied by the equivalent USCS designation)
- Descriptions of stratigraphic and lithologic structural features encountered. Non-native (import fill) material should be documented and it is recommended to document the depth of the non-native material
- Moisture content (wet, moist, dry), degree of weathering, color (referenced to Munsell color charts), and stain
- If field monitoring device (e.g. OVA, HNu) is used, the data from these measurements including background concentrations
- Depth to water-bearing unit(s) and vertical extent of each water-bearing unit
- Depth of borehole and reason for termination of borehole
- Depth, location, and identification of any evidence of contamination (e.g., odor, staining) encountered in borehole
- Observations made during drilling (e.g., advance rate, water loss)
- Observations made during sampling (e.g., blow counts, sample recovery)
- Material used to backfill borehole

7.4.4.3 CHAIN-OF-CUSTODY

COC records are used to document sample collection and shipment to the laboratory for analysis. A COC record should accompany each sample shipment in order to identify the contents of each shipment and maintain the custodial integrity of the samples. A

copy of the form should be included in Appendix G. A sample is considered to be in someone's custody if it is either in someone's physical possession, in someone's view, locked up, or kept in a secured area that is restricted to authorized personnel. Until receipt by the laboratory, the custody of the samples should be the responsibility of the sample collector or courier.

After placement of each sample in its protective plastic bag, the bag should be sealed and evidence tape placed about the end of the bag. The shipping containers in which samples are stored (usually a sturdy picnic cooler or ice chest) should also be sealed with evidence tape any time the containers are not in someone's possession or view and during shipment to the laboratory. These seals should be signed and dated.

7.4.4.4 PHOTOGRAPHS

Photographs should be taken as needed at areas of interest onsite. They should serve to verify information entered in the field logbook. When a photograph is taken, the following information should be written in the logbook or should be recorded in a separate field photography log:

- Time, date, location, and, if appropriate, weather conditions;
- Description of the subject photographed, including sample identification number;
- Point-of-view orientation of the photo (e.g., to the west; to the east-southeast);
- Name of person taking the photograph.

7.4.4.5 FIELD ANALYSIS DOCUMENTATION

When field instrument is used for measurements, e.g., x-ray fluorescence (XRF) is used for lead analysis or handheld instrument is used for methane measurement, field analysis data package should require the following:

- Narrative with signature of instrument operator (e.g., certified XRF technician).
- Chain of custody indicating sample collection dates and times.
- Analytical results
- Daily calibration data
- Blank results
- Duplicate sample results
- Confirmation data
- Associated raw data

Refer to *Interim Guidance, Evaluation of School Sites with Potential Soil Contamination as a Result of Lead from Lead-Based Paint, Organochlorine Pesticides from Termiticides, and Polychlorinated Biphenyls from Electrical Transformers (DTSC 2006 a)* for additional information on documentation of XRF field analysis.

7.5 SAMPLE ANALYSES

The analytical program of the investigation should be developed in the FSP. It is recommended to describe in the text the quantity of samples that will be analyzed by

each method. It is also recommended to detail the quantity of each analysis at the proposed depths. This will give an overall scope of the analytical program. Methods used to analyze each sample should be included in Table 1.

The laboratory(s) that will be used for the investigation should be indicated in the FSP. An accredited laboratory should be used for the sample analysis. The laboratory should be accredited through Environmental Laboratory Accreditation Program (ELAP) or National Environmental Laboratory Accreditation Program (NELAP). Soil gas and air laboratories are not regulated by an accreditation program. It is recommended to request performance evaluation (PE) results from these laboratories for any method that may be used for the investigation.

In order to confirm project detection limits with the associated compounds, the laboratory should submit the list of analytes for each method with the associated detection limits. If duplicate samples are sent to another laboratory, the detection limits should at least be as low as the primary laboratory detection limits to meet the projects data quality objectives.

7.5.1 Field

This section should discuss field analyses, such as x-ray fluorescence (XRF), including the preparation and analytical method, analytes, quantitation limits, holding times, and preservation that should correlate with Table 2.

7.5.2 Laboratory

This section should discuss laboratory analyses, including the preparation and analytical method, analytes, quantitation limits, holding times, and preservation that should correlate with Table 2.

7.6 INVESTIGATION DERIVED WASTE

This section of the report should describe the management and disposition of wastes generated during the investigation, including soil cuttings, personal protective equipment, decontamination water, etc. Management and disposition of wastes should be consistent with the U.S. EPA Guide to Management of Investigation-Derived Wastes (U.S. EPA 1992).

7.7 ADDITIONAL INFORMATION FOR MEDIA-SPECIFIC FIELD SAMPLING PLANS

The following information for media-specific field sampling plans should supplement the general guidelines for field sampling plans.

7.7.1 Geophysical Survey

It is suggested that the investigator contact an expert in geophysics, (i.e. a geophysicist registered in the State of California), to determine if a geophysical survey would be beneficial for a particular investigation. Furthermore, an expert can recommend which

technique or techniques would be most effective given the specific circumstances of the investigation.

The sampling plan for a geophysical survey should include the following information:

- Objectives for conducting a geophysical survey consistent with the DQOs, such as locating buried objects (underground storage tanks, pipes, and drums), mapping landfill boundaries, detecting leachate, or revealing contaminant migration pathways.
- Geophysical techniques to be used (magnetic methods, ground penetrating radar (GPR), borehole logging, and electromagnetic methods (EM)).
- Resolution and sensitivity of the method.

7.7.2 Soil Gas

A field sampling plan for soil gas should be prepared in accordance with the *Advisory – Active Soil Gas Investigations* (DTSC/LARWQCB 2003). This advisory details soil gas sampling probe installation, sampling, and analytical procedures. The most current version of this guidance should be used.

The field sampling plan for soil gas should include the following information:

- Sampling objectives – Objectives for conducting soil gas sampling consistent with the DQOs.
- Sampling approach – Description of the sampling strategy to be used (biased, random, systematic, or other).
- Sampling locations and rationale – Sampling locations should be presented on a site plan. The site plan should be of sufficient detail to clearly show sampling locations relative to the associated recognized environmental condition. Sampling locations, depths, designation, rationale, sample container, and analyses identified in a table.
- Sample collection – Description of the step-by-step procedures of how each sample will be collected.
- Sampling equipment and procedures – Description of sampling equipment to be used, decontamination procedures, and sampling preparation.
- Containers and preservation
- Packaging and shipment
- Documentation
- Sample analyses (field and laboratory)

7.7.3 Soil Matrix

A field sampling plan for soil matrix should include the following information:

- Sampling objectives – Objectives for conducting soil gas sampling consistent with the DQOs.

- Sampling approach – Description of the sampling strategy to be used (biased, random, systematic, or other).
- Sampling locations and rationale – Sampling locations should be presented on a site plan. The site plan should be of sufficient detail to clearly show sampling locations relative to the associated recognized environmental condition. Sampling locations, depths, designation, rationale, sample container, preparation (composite, discrete), and analyses identified in a table.
- Sample collection – Description of the step-by-step procedures of how each sample will be collected, including the type of sample (discrete, grab, composite, or continuous core).
- Sampling equipment and procedures – Description of sampling equipment to be used, decontamination procedures, and sampling preparation.
 - If VOCs are to be analyzed, EPA Method 5035A should be used and the number of sub-cores collected per sample should be indicated. A minimum of three sub-cores per sample should be collected for each discrete sample with one sample in a batch of twenty samples or less should have a minimum of five sub-cores collected for QC purposes. The weight of all sub-cores should be described in the sampling plan. It is recommended to find out from laboratory the weights to be used for the sub-core sampling. Indicate in the sampling plan whether field preservation will be implemented.
 - It may be necessary to homogenize and/or sieve the samples, for example for XRF analysis. A SOP for sample homogenization should be described in the sampling plan.
 - Discussion describing the collection method and the equipment necessary to collect the samples such as the type of drill rig, direct push rig, hand auger, etc.
 - Discussion of any screening methods and equipment such as PID and/or field bioassays.
 - Continuous cores are often collected as part of the sampling plans. A discussion about the collection of the continuous cores, the equipment used, and how they will be logged.
 - Discussion regarding the material used for backfilling the boreholes.
- Containers and preservation
- Packaging and shipment
- Documentation
- Sample analyses (field and laboratory)

To assess health risk, indoor air quality, the threat of groundwater contamination from VOCs, or to evaluate the effectiveness of a proposed remedial technology, the following soil matrix parameters should be obtained from a minimum of three (3) sample locations (at depths corresponding to or associated with the detected VOCs) for each soil type in association with the soil investigation:

- Soil description performed and presented in accordance with the Unified Soil Classification System (USCS)

- Density
- Organic carbon content of the soil (Walkee Black Method)
- Soil moisture
- Effective permeability
- Porosity
- Grain size distribution analysis (curve)

7.7.4 Groundwater

A field sampling plan for groundwater should include the following:

- The total number of groundwater samples collected and a Sample Location Map. Rationale should be described to support the sampling strategy and frequency of sampling.
- A table should be incorporated describing sample identification, depth of well, screen depth, and analysis.
- Description of well types such as hydro punch, temporary, or permanent monitoring wells.
- Description of the well development process.
- A picture of the well's construction should be presented in the work plan and a description of the well's materials (casing, screen, well head)
- Discussion of pre-sampling activities:
 - Measurement of static water level elevation
 - Detection of immiscible layers, LNAPL and DNAPL
 - Well purging
- Discussion of sample collection such as bailers, low flow purge (micro-purge) bladder pumps, passive diffusion bags, and snap samplers, etc. Peristaltic pumps are not recommended for samples collected for VOC analysis.
- A copy of a blank field log (purging and sampling log sheet). This log should contain the following information:
 - Well identification
 - Condition of well and surface completion
 - Well depth
 - Static water level depth and measurement technique
 - Presence and thickness of immiscible layers and detection method
 - Well purging procedure and equipment
 - Purge volume and pumping rate
 - Time well purged
 - Well yield (high or low)
 - Well recovery after purging (slow, fast)
 - Collection method for immiscible layers
 - Sample withdrawal procedure, flow rate if applicable, and equipment
 - Date and time of collection
 - Well sampling sequence
 - Types of sample bottles used
 - Preservatives used

- Field observations of sampling event
- Name of collector
- Climatic conditions, including air temperature

The following recommendations are provided as a guide to sampling groundwater for the analysis of trace metals:

- Filtered samples for dissolved metals should be used whenever groundwater samples are collected to determine if water quality has been affected by a hazardous substance release that includes metals as a constituent of concern. The filtered samples should be preserved after filtration.
- Samples should never be filtered when a water supply well is sampled.
- For risk assessment, unfiltered samples should also be considered if colloidal transport in the aquifer could be significant. It is also recommended that filtered samples be collected at the same time for comparison.
- A SOP for filtration in the field should be submitted in the FSP.

7.7.5 Surface Water

A field sampling plan for surface water should include the following:

This should apply to the collection of representative liquid samples from streams, rivers, lakes, ponds, lagoons, and surface impoundments.

- The total number of samples collected and a Sample Location Map. Rationale should be described to support the sampling strategy.
- A table should be incorporated describing sample identification, indicate the depth of sample or whether it is a surface sample, method of analysis, sample container, and holding time.
- The hydrology and physical parameters of the water body should be determined prior to sampling. This will aid in determining the presence of phases or layers, flow patterns and appropriate sample locations and depths.
- Water quality data should be collected from lakes, ponds, lagoons, and surface impoundments and to determine if stratification is present. Measurements of dissolved oxygen, pH, temperature, conductivity, and oxidation-reduction potential (ORP) can indicate if strata exist which would effect analytical results.
- Indicate how the samples will be collected: from a boat or the shore.
- Indicate the equipment used for sample collection.
- Indicate overall depth and flow direction

- Indicate the method to mark sample locations: stakes, flagging, buoys. If collecting sediment samples, this procedure may disturb the bottom.
- If using the direct method to sample, collecting water samples from the surface directly into the sample bottle, do not use pre-preserved sample bottles as the collection method may dilute the concentration of preservative necessary for proper sample preservation.

7.7.6 Sediment

Sediments are those mineral and organic materials situated beneath an aqueous layer. Substrate particle size and organic matter content are a direct consequence of the flow characteristics of a water body. Contaminants are more likely to be concentrated in sediments typified by fine particle size and high organic matter content. This type of sediment is most likely to be collected from depositional zones. In contrast, coarse sediments with low organic matter content do not typically concentrate contaminants and are generally found in erosional zones. The selection of a sampling location can greatly influence the analytical results.

Surface sediment is considered to range from 0 to six inches in depth and a shallow aqueous layer. Collection of sediment samples beneath a shallow aqueous layer of 0 to 12 inches in depth can be accomplished with tools such as spades, shovels, trowels, and scoops. Collection of sediment samples beneath an aqueous layer greater than 12 inches in depth can be accomplished by a bucket or tube hand auger or a dredge sampling device with spring activated jaws.

A field sampling plan for sediment should include the following:

- The total number of samples collected and a Sample Location Map. Rationale should be described to support the sampling strategy.
- A table should be incorporated describing sample identification, indicate the depth of sample, method of analysis, sample container, and holding time.
- Indicate the method to mark sample locations: stakes, flagging, buoys.
- Indicate specific site factors including water flow direction and rate, overall water depth, contaminant source and extent and nature of contamination should be considered when selecting sample locations.

7.7.7 Air

A field sampling plan for air should include the following:

- The total number of samples collected and a Sample Location Map. Rationale should be described to support the sampling strategy and frequency of sampling. An optimal sampling strategy accounts for the following site parameters:

- Location of stationary as well as mobile sources
 - Analytes of concern
 - Analytical detection limit to be achieved
 - Rate of release and transport of contaminants from sources
 - Meteorological monitoring data
 - Meteorological conditions in which sampling is to be conducted
- A table should be incorporated describing sample identification, method of analysis, sample container, and holding time.
 - A table should be incorporated describing the time, duration, and frequency of sampling events. If sampling techniques require samples to be collected over a period of time, the sample volume is obtained by multiplying the sample time in minutes by the flow rate. Sample volume should be indicated on the chain of custody.
 - Background samples may be recommended prior to field work depending on the analysis. Upwind sources can contribute to sample concentration. Natural sources, such as biological waste, can produce hydrogen sulfide and methane which may contribute to the overall contaminant level. Extraneous anthropogenic contaminants (VOCs from petrochemical facilities, emissions from vehicular traffic, and effluvium from smoke stacks) may also contribute.
 - Indicate the equipment used for air sampling and/or air monitoring.

7.7.8 Background

The following information should be presented for background samples:

- Medium being investigated (water, soil, soil gas, or air).
- Location - Background samples should be collected at or near the site but not in areas likely to be influenced by the contamination and/or facility operations (past or present). Background samples should be collected from locations that are upgradient/upwind/upstream of the suspected contamination.
- Number of samples - It is unlikely that a sufficient number of background samples will be collected during the SSI investigation to be considered statistically valid. However, the information is useful in comparing relative ranges of background results to onsite contamination. It is recommended that a minimum of four (4) locations be collected to determine that the average contaminant concentration that is not a result of releases from the site.
- Analysis - Background samples should be analyzed for naturally occurring compounds. With few exceptions, one may assume that background levels for manmade chemicals are zero. The few exceptions may arise when an off-site source has contributed to the onsite contamination or the site is part of a regional contamination problem.

Each background sample should be collected from strata similar to onsite samples to which they can be compared. If initial sampling reveals a high variability between levels

in each sample, more samples should be collected to increase the confidence in the average.

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8.0 QUALITY ASSURANCE PROJECT PLAN

A quality assurance and quality control (QA/QC) program should be specified in Quality Assurance Project Plan (QAPP) to provide an appropriate level of assurance regarding the reliability and usability of the data generated during the proposed environmental sampling investigation. The QAPP should be summarized in this section and included in Appendix C. The overall QA/QC should ensure that sampling, analysis and reporting activities provide data quality consistent with the intended use. The QA objectives are to assure that the collected data will be accurate, precise, representative, and legally defensible. QC represents the specific steps and procedures to be followed during the course of the project to achieve QA. The primary QC features include collection and analysis of QC samples, field audit, and data validation.

As part of the QA/QC program, data validation should be conducted to evaluate performance of data collection against pre-determined methods, procedural, or contractual requirements specified in the FSP. It routinely assesses how closely the FSP has been followed during data generation in the field and laboratory. It checks for improper practices, abuse and warning signs shown during the sampling investigation.

The purpose of the data validation is to determine both the quality of the data based on compliance with all QA measures and the achievement of a project's data quality objectives (DQOs). It determines if the available data satisfies the project's DQOs and data use requirements by evaluating the data reports for field sampling procedures, laboratory performance and error checks. Data validation generally includes reviews of the following items:

- project QC program,
- sampling procedures,
- analytical procedures,
- data reports, and
- DQOs.

8.1 REVIEW OF PROJECT QC PROGRAM

The FSP should include a QC program for the proposed sampling and analysis. To ensure that data is of the highest confidence and known quality to satisfy the project objectives and to meet or exceed the requirements of the standard methods of analysis, review of the project QC program should include evaluation of the project's QC procedures and QC samples. Any deficiencies and impacts (e.g., deviations caused by newly discovered site conditions) should be identified and discussed, and appropriate corrective actions recommended and taken.

8.1.1 QC Procedures

QC procedures, required to ensure that the site conditions and nature and extent of contamination are properly evaluated, include:

- adherence to strict protocols for field sampling and decontamination procedures;
- collection and laboratory analysis of appropriate field equipment and trip blanks to monitor for contamination of samples in the field or the laboratory;
- collection and laboratory analysis of matrix spike (MS), MS duplicate (MSD), and field duplicate samples to evaluate precision and accuracy; and
- attainment of completeness goals.

Evaluation criteria for basic QC procedures should include, but are not limited to, field decontamination, supplies, holding times, equipment calibration and maintenance, and standards, as described below:

- **Field Decontamination:** Non-dedicated equipment should be decontaminated before and/or after each sample collection. The equipment should be washed with a non-phosphate detergent, rinsed in potable water, and double rinsed with distilled water. A description of the specific methodologies followed to maximize proper equipment decontamination and with consideration for collection of equipment rinsate samples should be provided.
- **Supplies:** All supplies should be certified clean or new by the suppliers, inspected by the project team prior to their use, and monitored by the employed laboratory through the use of standards and blank samples as appropriate. Appropriate supplies, e.g., special water sample bottle for paraquat analysis, should be clearly specified. The description for sample collection and analysis contained in the methods should be used as a guideline for establishing the acceptance criteria for supplies.
- **Holding Times:** Holding time is the maximum time samples may be held prior to analysis and still be considered valid. It starts at the time of sample collection. Holding time for each analytical method and analyte should be provided and any holding time shorter than 30 days be clearly specified. If holding times are exceeded, and the analyses are performed, the associated results should be qualified.
- **Preventative Maintenance and Standards:** Analytical equipment should be properly calibrated and maintained as recommended by manufacturers and/or described in the employed laboratory's QA plan and Standard Operating Procedures (SOPs). Procedures specific to the calibration, use and maintenance of field equipment should be presented in the FSP. Standards used for laboratory equipment calibration or to prepare samples should be current, labeled with valid expiration dates and certified by or traceable to National Institute of Standards and Technology (NIST) or other equivalent source. The laboratory's documentation of compliance and raw data should be made available to DTSC upon request and may be subject

to audit by inspectors of the oversight agency and/or ELAP. The laboratory QA plan and SOPs should be included in the FSP or maintained in the project file.

8.1.2 QC Samples

To check for precision and accuracy of project data, appropriate QC samples should be collected for analysis at the specified frequency. These include field QC samples, background samples, split samples, field measurement confirmation samples, laboratory QC samples and/or positive confirmation samples. QC samples for soil gas investigations are specifically specified in DTSC's "Advisory – Active Soil Gas Investigations, dated January 28, 2003" (or its current version). QC samples for other investigations are discussed below. All proposed sample locations (including QC samples) should be identified and a rationale provided for the choice of location in the FSP.

8.1.2.1 FIELD QC SAMPLES

Field QC samples, used to evaluate conditions resulting from field activities, include blanks (for assessment of field contamination) and duplicates (for assessment of sampling variability). They should be samples expected to contain moderate levels of contamination and should be collected, preserved, packaged, stored, transported, and analyzed in a manner consistent with site samples. Field QC samples should be sent to the laboratory blind.

Field duplicates should be collected from areas of known or suspected contamination at a rate of at least 10 percent (%) of primary samples collected per analyte per sample matrix per event.

Common blanks are equipment rinsate blanks, field blanks, trip blanks and temperature blanks as described below:

- **Equipment Rinsate Blanks:** When decontamination of re-useable, non-disposable sampling equipment (e.g., hand augers, direct push rods, groundwater sampling pumps) is necessary, at least one (1) equipment rinsate blank per analyte per day (per 10 samples?) should be collected by pouring de-ionized or distilled water through the decontaminated or cleaned sampling equipment used for sampling.
- **Field Blanks:** When no equipment decontamination is required at all (e.g., utilization of one-time-use spoons for surface sampling or direct collection of groundwater samples from existing well valves), at least one (1) field blank per sample matrix per analyte per day should be collected by pouring de-ionized distilled water (or proper sampling medium standards as necessary) into a sample container at a specific sampling point.
- **Trip Blanks:** When transportation and offsite analysis of volatile organic compound (VOC) samples are needed, at least one (1) trip blank per sample matrix should accompany every shipment of blank containers shipped to the field and VOC samples shipped from the field (except for canister samples of VOCs or otherwise

specifically exempted by the oversight agency). Trip blanks should be obtained by filling appropriate sample containers with clean medium which are free of VOCs and in the same matrix of site VOC samples.

- When temperature variation is critical to sample integrity (e.g., when low temperature sample preservation is required), one (1) temperature blank, consisting of a 40 milliliter (mL) VOA vial of clean water labeled “temperature blank,” should be included in each shipment cooler.

8.1.2.2 BACKGROUND SAMPLES

A minimum of four (4) background sample locations per medium should be chosen from non-impacted, upgradient, upwind and upstream areas (with similar strata to proposed sampling locations) onsite or near the site. Background metal data from a nearby site with similar strata conditions may be utilized instead. However, collection of background lead and arsenic samples may not be required because DTSC’s initial screening values for lead and arsenic in soil at school sites can be utilized for data interpretation and screening risk evaluation, unless it is wanted to differentiate between onsite and offsite contributions to contamination. In addition, risk assessment calculations should be made with all detected naturally occurring compounds, with the exception of lead and arsenic, assumed to be chemicals of potential concern (COPCs).

8.1.2.3 SPLIT SAMPLES

Split samples are samples that physically divided (or co-located when volatilization is not a problem) and analyzed by different laboratories for the purpose of providing an inter-laboratory or inter-organization comparison. For example, metal samples may be divided in half after being homogenized thoroughly in a pail. DTSC or interested parties (e.g., potential responsible parties, property owners, or community members) may request split samples for performing independent analyses.

8.1.2.4 FIELD TEST CONFIRMATORY SAMPLES

When field instrument is used for measurements, e.g., x-ray fluorescence (XRF) is used for lead analysis or handheld instrument is used for methane measurement, field test confirmatory samples should be collected in addition to routine QC samples (e.g., duplicates and standard samples). Follow the appropriate DTSC guidance documents for number and frequency of field test confirmatory samples.

8.1.2.5 LABORATORY QC SAMPLES

As part of standard laboratory QC protocols, each laboratory monitors the performance (precision and accuracy) of the results of its analytical procedures through analyses of laboratory QC samples as specified in the laboratory QA plan/SOPs and the analytical method requirements. Laboratory QC samples include method blanks, reagent spikes, laboratory duplicates, laboratory control spike (LCS) samples, matrix spikes (MS) and matrix spike duplicates (MSD), surrogate compounds, positive confirmation samples, initial and continuing calibration checks, tuning checks, and/or performance evaluation (PE) samples. Required laboratory QC samples for each project should be identified

and additional sample amount (e.g., a double or triple volume) collected for that purpose to avoid collection of a separate sample for laboratory QC purposes. Any samples with visual sign of contamination should be noted to the employed laboratory for possible preparation of laboratory QC samples.

The requirements for laboratory QC samples vary. However, the frequency for laboratory QC samples should be at least one (1) per batch of up to 20 total samples (including blanks and duplicates), five percent (5 %) of the primary field samples or 14 days, whichever requires greater number of laboratory QC samples. Common laboratory QC samples are described below.

- **Method Blanks:** Method blank at the specified frequency should be analyzed to assess the level of background interference or contamination in the analytical system (during sample preparation and analysis). When compounds are found in the blank, their values are evaluated to determine their effect on the analysis of environmental samples.
- **MS and MSD Samples:** MS and MSD pair at the specified frequency should be analyzed to evaluate the precision and accuracy of the procedures and to check sample matrix interferences.
- **LCS Samples:** LCS samples are clean matrices (e.g., reagent water or a clean solid such as sand, glass beads, or sodium sulfate) that have been spiked with a known quantity of a compound or group of compounds and are processed with every analytical batch of environmental samples. The percentage of the compound that is recovered in the analysis provides a measure of method accuracy. When analysis of the LCS is repeated, the standard deviation provides a measure of analytical precision. LCS sample at the specified frequency should be analyzed.
- **Laboratory Duplicates:** When the MS/MSD pair does not meet the precision or accuracy requirements or otherwise as appropriate, laboratory duplicate at the specified frequency should be prepared and analyzed in the laboratory.
- **Positive Confirmation Samples:** For samples detected positive with certain analyte (e.g., perchlorate), the presence of the analyte in the positive samples may need to be analyzed and confirmed by a more sensitive method. See appropriate methods or regulatory guidance for appropriate requirements.
- **Performance Evaluation (PE) Samples:** Standard or project-specific PE samples may be submitted to the analytical laboratory during any site investigation to assess the precision and accuracy of analytical procedures employed for a given sample set. PE samples may be submitted for analysis as part of the laboratory pre-qualification process for a given sampling event. If questionable data quality is suspected as determined during laboratory audits or data validation, PE samples should be used. Results will be reported to the laboratory and presented with associated field sample results.

8.2 REVIEW OF SAMPLING PROCEDURES

Field activities should be planned, conducted and completed in a manner consistent with the FSP and be monitored through a field audit and photo documentation. Review of sampling and handling procedures should involve evaluation of utility clearance, field tests, field documentation, boring logs, sample conditions, investigation derived waste (IDW) management, and field audits.

Proper utility clearance should be completed prior to initiating any soil intrusion work. Field tests may be used in conjunction with confirmation samples analyzed in a fixed laboratory. Specific field analyses for pH, conductivity, turbidity, or others (e.g., immunoassay tests, XRF tests, soil gas investigations) should be discussed in the FSP.

Field logs and other documentations should be reviewed regarding sampling procedures, e.g., sample containers, collection, preservation, packaging, transportation, receipt, handling and storage, sample identification, chain of custody, holding time, and decontamination procedures. Upon receipt, the employed laboratory should inspect sample conditions and report the information accordingly on the chain of custody forms. Boring logs for any boring depth of 5 feet or deeper should be prepared under supervision of a California registered professional (e.g., professional civil engineer or geologist) in accordance with the California Business and Professions Code.

IDW should be managed as hazardous waste until proven otherwise or until specifically approved by DTSC as being non-hazardous waste. IDW should be properly drummed, labeled and securely onsite until an appropriate means of disposal can be determined. To ensure appropriate disposal of IDW, the average levels of all analytical results may be used to determine whether the IDWs are hazardous waste.

During the course of field work, routine field audits should be conducted. DTSC will also provide field oversight to spot check field work.

8.3 REVIEW OF ANALYTICAL PROCEDURES

The FSP should discuss the analyses requested, analytes of concern, turnaround times, and available laboratories. Review of analytical procedures includes laboratory accreditation, analytical methods, laboratory QC samples, internal standards, retention time windows, reporting limits, instrument calibration, tentatively identified compounds (TICs), and laboratory audits.

- The employed laboratory shall be ELAP or NELAP certified for the analysis requested unless no such certification is available for the analysis.
- It is DTSC's policy to use only the test methods found in SW-846 and California Code of Regulation, Title 22, for analysis of hazardous constituents, unless otherwise specifically allowed by DTSC. All analyses should be performed as specified in the requirements of DTSC-approved analytical methods and the employed laboratory's standard operating procedures (SOPs) and QA plan.

- The common laboratory QA/QC procedures include method blanks, surrogates, matrix spike and matrix spike duplicates, laboratory duplicates and initial and continuing calibration checks.
- If the internal standard recovery falls outside of acceptable criteria, the instrument should be checked for malfunction and reanalysis of the sample should be performed after any problems are resolved.
- Retention times should be checked on a daily basis. If the retention time for an analyte falls outside its respective window, the instrument should be recalibrated and the affected samples be reanalyzed.
- Review of surrogates, retention time window and TICs is not necessary for inorganic analyses.
- All collected samples should be delivered to the employed laboratory for appropriate analyses immediately after their collection. Samples not analyzed immediately should be archived by the laboratory for possible later analysis.
- Laboratory audits include reviews of sample handling procedures, internal sample tracking, SOPs, analytical data documentation, QA/QC protocols, and data reporting. If no previous audit has been conducted, a scheduled audit should be considered prior to selection of the laboratory or after discovery of significant laboratory discrepancies.

8.4 REVIEW OF DATA REPORTS

All laboratory reports should be comparable with previous USEPA Level II contract laboratory documentation. All data should be reviewed in accordance with the project sampling and analysis workplan, the employed laboratory's standard operating procedures (SOPs), the principles present in USEPA National Functional Guidelines for Laboratory Data Review – Organics (USEPA, 1999) and Inorganics (USEPA, 2002), and the professional judgment of the project validation team to ensure that the data produced are credible, cost-effective, and of known and defensive quality. The areas of data review should include:

- Completeness of the laboratory reports (e.g., laboratory/client/sample identifications, ELAP certification number, project name, sample matrix, analytes, analytical methods, sample collection/preservation/preparation/extraction/analysis dates, reporting units/limits, dilution factors, report page numbering system, designated title and signatures);
- Chain of custody;
- Analytical methods and reporting limits;
- Sample containers and conditions;
- Holding times;
- Sample preservation;

- Field QC samples (e.g., equipment blanks, field blanks, trip blanks, temperature blanks, duplicates, split samples, as applicable);
- Laboratory QC samples (e.g., method blanks, laboratory control samples, matrix spike and matrix spike duplicates, duplicates, as applicable);
- Surrogate recoveries (as applicable for organic analyses only);
- Compound identification and quantification;
- Dilution factors;
- Data qualifiers;
- Tentatively identified compounds (TICs);
- Confirmation of positive samples, as applicable
- Observations regarding any occurrences which may adversely affect sample integrity or data quality; and
- Case narrative describing all qualified data, TICs, variances, deviation or deficiencies encountered (during field sampling or laboratory analysis), possible reasons (with verifications), potential impacts, and corrective actions taken, if any.

If elevated levels of non-target compounds or TICs are detected, such as other heavy metals have been detected during the analysis of lead samples by Method 6010C, these non-target compound data should be discussed with DTSC before the data is included in the investigation report and submitted to DTSC for approval.

When significant discrepancies of analytical results are identified, a data audit should be performed to review the complete raw data files and supporting documentation, including verification of data calculations for calibration and QC samples. The data audit will determine if the deviations will result in any adverse effect on the project conclusions and if a corrective action is necessary.

8.5 REVIEW OF DATA QUALITY OBJECTIVES (DQOS)

Data quality objectives (DQOs) are qualitative and quantitative statements for establishing the criteria for data quality and for developing data collection designs. DQOs also establish the acceptable or appropriate levels of uncertainty associated with a set of data. Data quality may need to be legally defensible or simply capable of determining only the “presence-absence” question.

USEPA’s systematic planning guidance, “Guidance for the Data Quality Objectives Process (EPA QA/G-1, August 2000) should be used to define how environmental data will be used for environmental decision making. The seven steps of the DQO process are:

- State the Problem;
- Identify the Decision;
- Identify Inputs to the Decision;
- Define the Study Boundaries;
- Develop a Decision Rule;
- Specify Limits on Decision Error; and.

- Optimize the Design.

The “Specify Limits on Decision Errors” portion should contain supporting rationale for why the number of proposed samples and the proposed quality of the data are deemed appropriate for the data quantity and data quality needs. A statistical support, e.g., Visual Sample Plan available at <http://dgo.pnl.gov/vsp>, should be used to define a clear and defensible scientific rationale for the proposed sampling frequency.

The project DQOs should be evaluated to determine whether the quantitative and qualitative needs of the sampling and analysis program have been met. The DQOs should be specified in terms of specific data quality indicators (DQIs), i.e., precision, accuracy, representativeness, completeness, comparability, and reporting limits (RLs).

Qualitative DQIs are comparability and representativeness.

- Comparability expresses the confidence with which one data set can be compared to another for trends or changes (in space or time) at the site.
- Representativeness is the degree to which data accurately and precisely represent the actual site conditions through sufficient number of samples, appropriate sampling methodologies, necessary decontamination and proper QA/QC procedures.

Quantitative DQIs are precision, accuracy, completeness and RLs.

- Precision measures the reproducibility of repetitive measurements by assessing the standard deviation or relative percent difference (RPD) between analyses of the sample and the duplicate. The RPD limit for laboratory QC samples and site data of appropriate media (soil, soil gas and groundwater) should be provided in the FSP. RPD is calculated:

$$\% \text{ RPD} = 200\% |X_r - X_d| / (X_r + X_d),$$

where X_r is the measurement of the sample, and X_d is the measurement of the duplicate or replicate sample.

- Accuracy is a measurement of correctness by comparing a sample measurement with a known value. Field accuracy is achieved if no contamination is detected in equipment rinsate and trip blanks. Laboratory accuracy is achieved if all recoveries (expressed as the % recovery) of laboratory QC samples and initial and continuing calibrations of instruments are reported within the corresponding control ranges.
- Completeness is the amount of valid usable data obtained compared to the amount expected under ideal conditions. Completeness may be affected by such factors as sample bottle breakage and acceptance/non-acceptance of analytical results. At least 90% of the planned data results should be obtained and valid. Completeness is calculated:

$\% \text{ completeness} = 100\% \cdot (\text{number of valid results}) \div (\text{number of planned results})$

- Reporting Limits (RLs) should be low enough to 1) evaluate detected compounds against the screening levels, and 2) eliminate undetected compounds for further consideration in a quantitative risk assessment. As appropriate, screening levels may be risk-based criteria calculated in accordance with DTSC's guidance documents or published values, such as the California Human Health Screening Levels (CHHSLs) established by the California Office of Environmental Health Hazard Assessment (OEHHA), the Preliminary Remediation Goals (PRGs) by USEPA Region IX (including the Cal/EPA-modified PRGs)?, the Environmental Screening Levels (ESLs) by the San Francisco Bay Regional Water Quality Control Board, or regulatory standards. The planned RLs for soil gas samples should comply with the DTSC's Advisory – Soil Gas Investigations.

If matrix bias is suspected, the associated data may be qualified (as estimates or appropriate) and the direction of the bias indicated in the data validation report. If the DQOs or criteria are not fully achieved, such variances will trigger appropriate QA/QC measures needed to evaluate and correct the activities, as necessary; however, the data may not be considered invalid.

8.6 DATA VALIDATION MEMORANDUM

A data validation memorandum should be prepared by a qualified professional (e.g., laboratory director or chemist, project manager or QA/QC manager) to summarize the findings of a Level II data validation for all analytical results and included as Appendix F in the report. A sample Data Validation Memorandum is posted on DTSC webpage: http://www.dtsc.ca.gov/Schools/upload/Data_Validation.pdf. See the sample Data Validation Memo for more detailed requirements.

9.0 HEALTH AND SAFETY PLAN

If the activities described herein are consistent with and covered by a site-specific Health and Safety Plan (HASP) submitted with a PEA Technical Memorandum or Workplan approved by DTSC, this section should state that the health and safety procedures specified in a site-specified HASP reviewed by DTSC. This section should also provide a reference to this HASP, including a description of HASP location in the PEA Technical Memorandum or Workplan, title of the PEA Technical Memorandum or Workplan, author, date prepared, and date of the associated DTSC determination letter.

If the activities described herein have are not consistent with or covered by a site-specific HASP submitted with a PEA Technical Memorandum or Workplan approved by DTSC, this section should describe the HASP to be followed.

The HASP should be included as Appendix C. DTSC is not charged with the enforcement of occupational health standards and is not limited by such standards requiring health and safety information. DTSC review is based upon authority provided by the Health and Safety Code, title 22, and the Code of Federal Regulations. The authority to require a HASP be developed, submitted, reviewed and corrected to DTSC standards is found in the following state and federal regulations as well as DTSC policies and procedures:

- Health and Safety Code, section 25356.1, subdivision (d) - Remedial Action Plans (RAPs) must conform to the provisions of 40 Code of Federal Regulations part 300.400 et seq., with emphasis on 40 Code of Federal Regulations part 300.430, which requires a site specific health and safety plan which, at a minimum, should meet the requirements of the 29 Code of Federal Regulations part 1910.120.
- Health and Safety Code, section 25187.1, subdivision (a) - Grants DTSC the authority to issue orders to ascertain the nature and extent of hazards to human health or the environment.
- Health and Safety Code, section 25358.3, subdivision (b)(1) - Grants DTSC the authority to acquire information necessary to determine the extent of dangers present at a site.
- Health and Safety Code, section 25200.1.5, subdivisions (g)(3)(A) through (g)(3)(E) - Requires site operational conditions which includes physical and chemical hazards, potential accidents and actions taken to prevent them, training levels and contingency planning to be identified.
- Health and Safety Code, section 25356.1, subdivisions (h)(3)(A) through (h)(3)(D) - Allows DTSC to waive the requirements of a RAP if an approved

health and safety plan is provided, along with the satisfactory completion of remaining requirements.

- 40 Code of Federal Regulations part 300.430(b)(6) - All remedial investigations require the preparation of a site-specific health and safety plan.
- Health and Safety Code, section 25355.5, subdivision (a)(1)(B) - Grants DTSC the authority to issue an order requiring a RAP be submitted for DTSC approval.
- California Code of Regulations, title 8, section 5192 - Hazardous Waste Operations and Emergency Response: Details specific requirements for development of a HASP.
- 29 Code of Federal Regulations part 1910.120. Requires all hazardous materials workers to be trained and that a HASP and contingency plan be prepared.
- 40 Code of Federal Regulations part 311.1 - Provides all employees on hazardous waste sites are covered by a HASP.
- DTSC Policy and Procedure #86-20 (superceded by EO 93-009)- Remedial Action Orders and "enforceable" agreements: require a health and safety plan be submitted as part of the RI/FS workplan.
- DTSC Policy and Procedure #87-9 Walk-in Business: Work plans developed for walk-in business require site specific HASP be included.
- DTSC EO #93-009 Imminent and/or Substantial Endangerment Orders: requires the preparation of a site-specific HASP prior to the start of work.
- DTSC P/P 87-2 - The RAP process: requires that the health and safety risks at the site be identified.

The HASP should generally follow *Draft Site Specific Health and Safety Plan Guidance Document For Site Assessment/Investigation, Site Mitigation Projects, Hazardous Waste Site Work Closure, Post Closure, and Operation and Maintenance Activities* (DTSC 2000). The most recent version of this guidance document should be used and is available on the DTSC web page at www.dtsc.ca.gov [Only include if the HASP Template is posted on the DTSC Web site accessible by the public. The template is currently only available on the DTSC Intranet. Check with Kathleen Yokota-Wahl for status of posting to public web site]. The site-specific HASP, at a minimum, should include the following information:

- Facility background.
- Key personnel, including Site Safety Officer, and responsibilities.
- Safety and health risk or hazard analysis for each site task and operation found in the workplan.
- Employee training assignments (Cal. Code Regs., tit. 8, sec. 5192, subd. (e) (Training)).
- Personal protective equipment (PPE) to be used by employees for each of the site tasks and operations being conducted as required by the PPE program (Cal. Code Regs., tit. 8, sec. 5192, subd. (g)).
- Medical surveillance requirements (Cal. Code Regs., tit. 8, sec. 5192, subd. (f) (Medical Surveillance)).

- Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment to be used.
- Site control measures (Cal. Code Regs., tit. 8, sec. 5192, subd. (d) (Site Control)).
- Decontamination procedures (Cal. Code Regs., tit. 8, sec. 5192, subd. (k) (Decontamination)).
- An emergency response plan for same and effective responses to emergencies, including the necessary PPE and other equipment (Cal. Code Regs., tit. 8, sec. 5192, subd. (k) (Decontamination)).
- Confined space entry procedures (Cal. Code Regs., art. 108, Confined Spaces).
- Spill containment program (Cal. Code Regs., tit. 8, sec. 5192, subd. (j) (Handling Drums and Containers)).
- Procedures for providing potable water and sanitary facilities to site personnel (Cal. Code Regs., tit. 8, sec. 5192, subd. (n) (Sanitation at Temporary Workplaces)).
- Safe drum and container handling procedures (Cal. Code Regs., tit. 8, sec. 5192, subd. (j) (Handling Drums and Containers)).
- Procedures to verify that adequate illumination is afforded site personnel (Cal. Code Regs., tit. 8, sec. 5192, subd. (n)).]

Procedures should be included to identify and minimize potential off-site or community impacts from the activities described herein.

10.0 ENVIRONMENTAL MIGRATION SCREENING APPROACH

This section should discuss how the environmental migration screening evaluation will be conducted to evaluate potential impact to groundwater and surface water. The evaluation should utilize tools such as U.S. EPA soil screening values [Reference], criteria developed by the Regional Water Quality Control Boards, leaching models, or leachability tests. Sampling results, contaminant characteristics, and the CSM should be evaluated together to determine the environmental fate and transport of contaminants. Selection of tools should consider the most conservative criteria. If surface water may be impacted, an ecological screening evaluation may be necessary.

11.0 HUMAN HEALTH SCREENING APPROACH

[To be prepared by Human and Ecological Risk]

11.1 EXPOSURE PATHWAYS

11.2 CALCULATION OF CANCER RISK AND HAZARD INDICES

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12.0 PUBLIC PARTICIPATION

Public participation activities during the SSI should be described here and may include the following:

- If significant time has elapsed since previous field activities were conducted (e.g. PEA sampling), a fact sheet for SSI field activities may be helpful to keep the public informed.
- If it is reasonably anticipated that a response action will be required for the site, the school district can begin an assessment of community outreach activities conducted to date to help prepare for public participation activities during a response action.

13.0 ADDITIONAL REGULATORY REQUIREMENTS

This section should identify and discuss additional regulatory requirements applicable to the activities described herein, such as:

- Local fire department requirements
- Local building department requirements
- Regional or Local boring permits
- Other federal, state, or local requirements
- Contacting the appropriate regional notification center (e.g. Underground Service Alert, DigAlert, 1-800-227-2600, 811) prior to conducting any excavation (including grading, trenching, digging, ditching, drilling, auguring, tunneling, scraping, cable or pipe plowing, and driving) pursuant to Government Code sections 4216 through 4216.9.

14.0 PROJECT SCHEDULE

In order that all parties understand the objectives, tasks, and milestones of the project, a conceptual schedule should be discussed during the SSI scoping meeting. The schedule should consider school district needs and DTSC review timeframes. This section should include a schedule based on discussions during the SSI scoping meeting. At a minimum, the schedule should include tasks from submittal of the SSI Workplan through DTSC approval of the SSI Report. Schedules should be updated periodically in consultation with DTSC and may be modified based on site specific issues.

15.0 REFERENCES

The report shall include a references section to identify published referenced sources relied upon in preparing the SSI Workplan. Each referenced source shall be adequately annotated to facilitate retrieval by another party.

DTSC. 2006b. Data Validation Memorandum, Summary of the Level II Data Validation for Advanced Technology Report ATV5796, dated April 25, 2006." May 2, 2006.

DTSC. 2000. *Draft Site Specific Health and Safety Plan Guidance Document for Site Assessment/Investigation, Site Mitigation Projects, Hazardous Waste Site Work Closure, Post Closure, and Operation and Maintenance Activities*. December 2000.

United States Environmental Protection Agency (U.S. EPA). 1992. *Guide to Management of Investigation-Derived Wastes, Quick Reference Fact Sheet*. Office of Solid Waste and Emergency Response. Publication 9345.3-03FS. January 1992.

16.0 SIGNATURE AND QUALIFICATIONS OF RESPONSIBLE PROFESSIONALS

The following requirements exist for specific work that may be conducted during environmental assessments, investigations, or cleanup of school sites:

- All engineering work shall be conducted in compliance with the Professional Engineers Act (Bus. & Prof. Code, § 6700 et seq.) and Rules of the Board for Professional Engineers and Land Surveyors (Cal. Code Regs., tit. 16, § 400 et seq.).
- All geologic work shall be conducted in compliance with the Geologist and Geophysicist Act (Bus. & Prof. Code, § 7800 et seq.) and Rules of the Board for Geologists and Geophysicists (Cal. Code Regs., tit. 16, § 3000 et seq.).
- Contractors engaging in removal or remedial actions must be a licensed hazardous substance contractor with the Contractors' State License Board (Bus. & Prof. Code § 7058.7).

FIGURE 1 SITE LOCATION MAP

This map should include a north arrow, be to scale, and show the general location of the site relative to its surrounding area, including major highways, surface water bodies, land use, sensitive populations, and critical habitats.

FIGURE 2 SITE VICINITY MAP

This map should include a north arrow, be to scale, and be of sufficient detail to show adjacent property uses.

FIGURE 3 SITE PLAN

This plan should include a north arrow, and be to scale, and be of sufficient detail to show significant site features, including site boundaries, land use, paved areas, structures, and drainage patterns.

FIGURE 4 AREAS OF CONCERN

The areas of concern should be clearly shown overlaid onto the site plan.

FIGURE 5 CONCEPTUAL SITE MODEL

Examples of figures used to show the conceptual site model of the site may include, but are not limited to, the following:

- Figure 5A – Potential Exposure Scenarios
- Figure 5B – Iso-concentration Contour Map
- Figure 5C – Groundwater Elevation Contour and Flow Map
- Figure 5D – Geologic Cross-Section

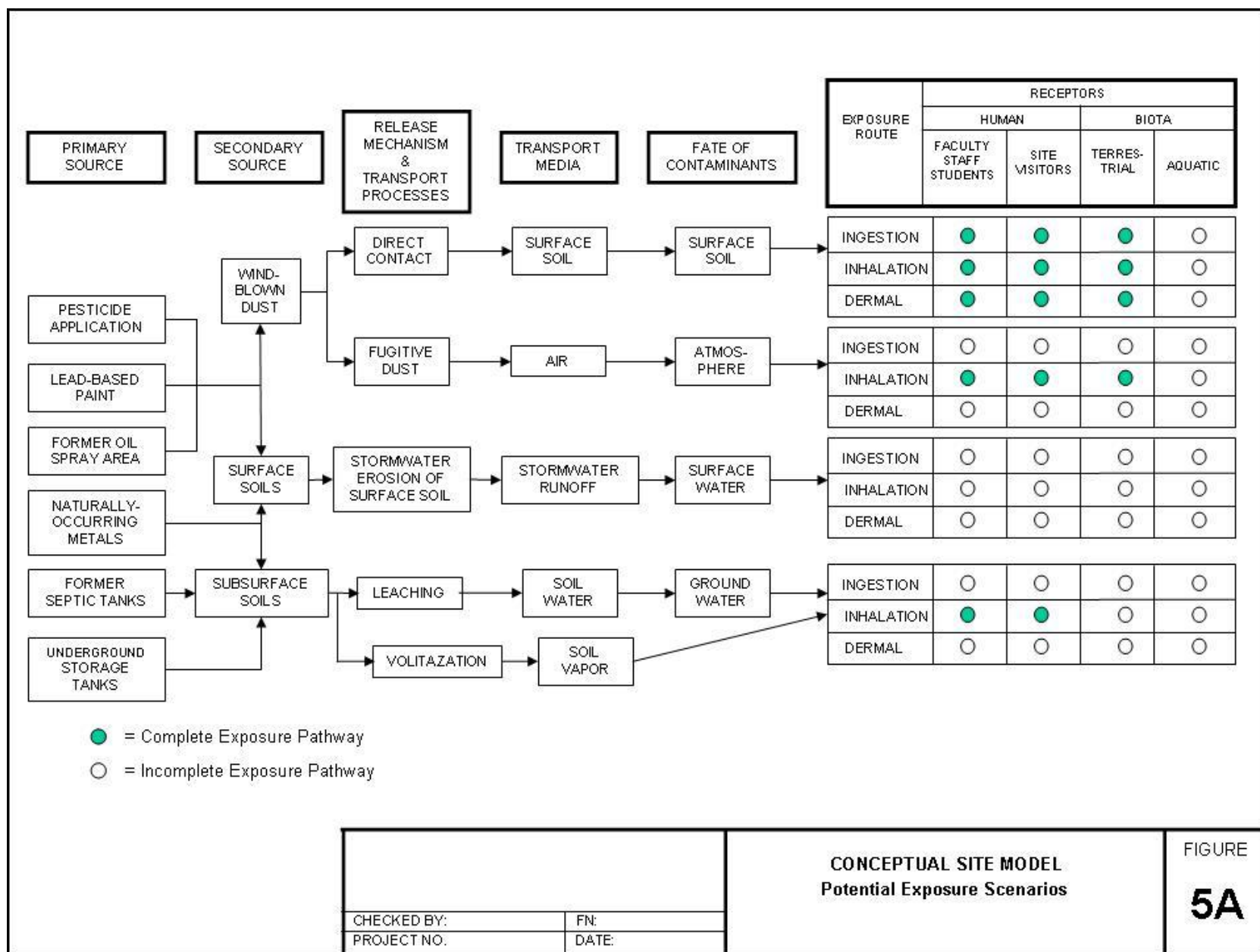
Use of these figures will depend on the complexity of the site.

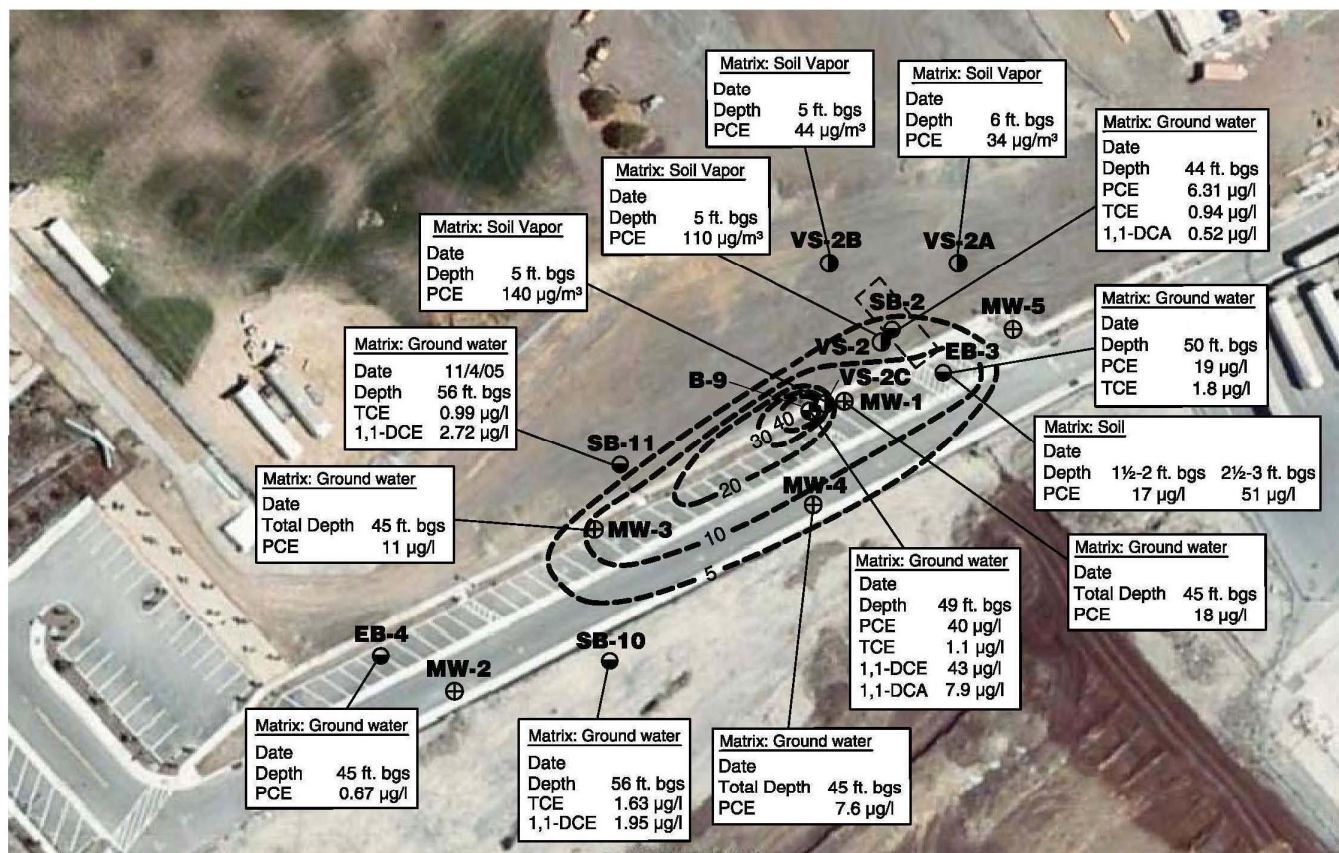
FIGURE 6 SITE PLAN WITH PREVIOUS AND PROPOSED SAMPLING LOCATIONS

This figure should show the previous samples collected and the associated analytical results. This figure should also show the samples to be collected overlaid onto the Site Plan. The figure should clearly show the sampling locations relative to the areas of concern. The sample locations, depths, and matrix should be clearly presented.

FIGURE 7 PROJECT SCHEDULE

This figure should include the project schedule. At a minimum, the schedule should include tasks from submittal of the SSI Workplan through DTSC approval of the SSI Report.





LEGEND

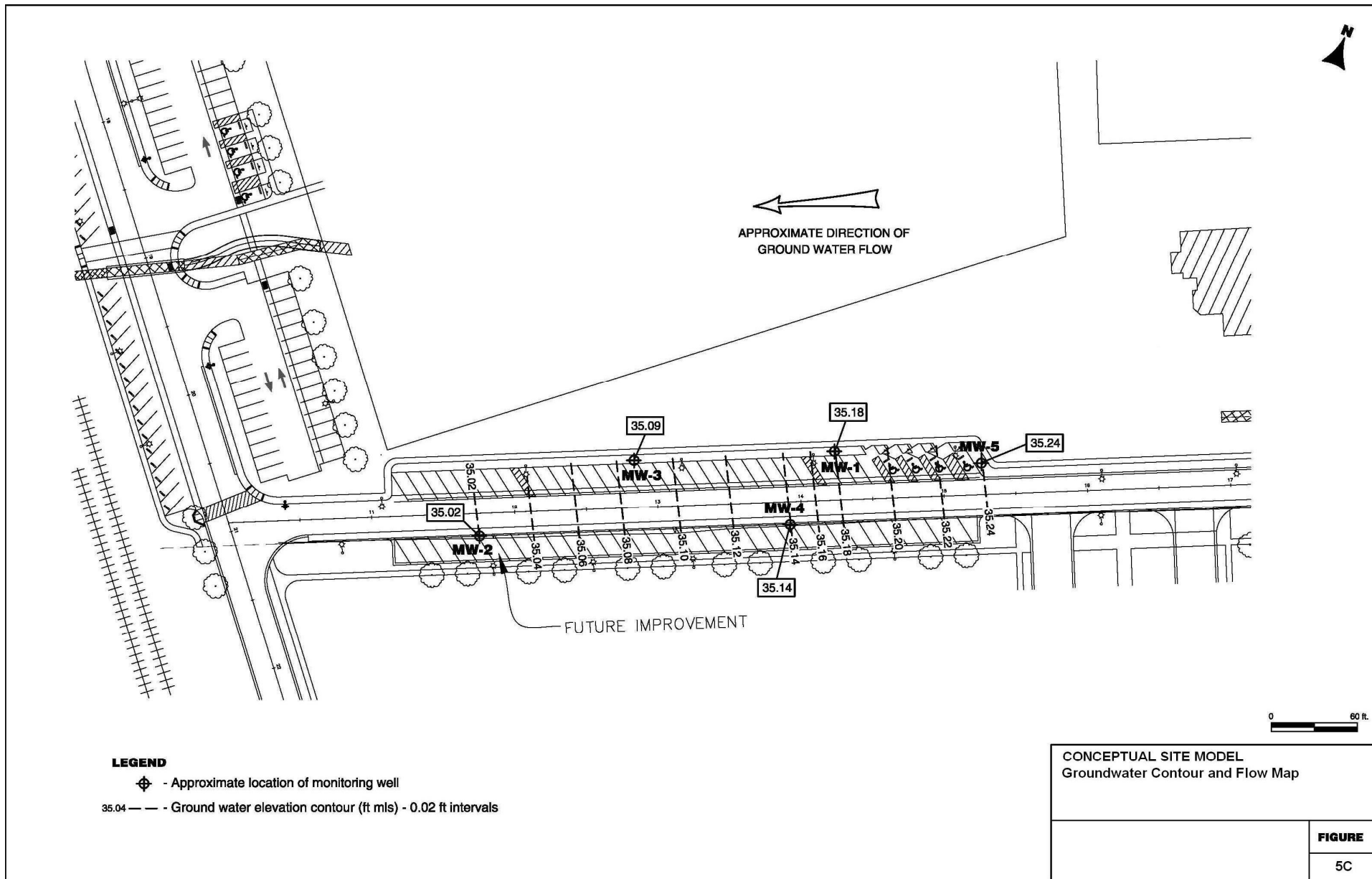
- ⊕ - Approximate location of ground water monitoring well
- - Approximate location of soil vapor sample
- ⊙ - Approximate location of boring
- - Approximate location of boring
- - Former rail spur/solvent compound building
- 10 - Iso-concentration contour of PCE in µg/l

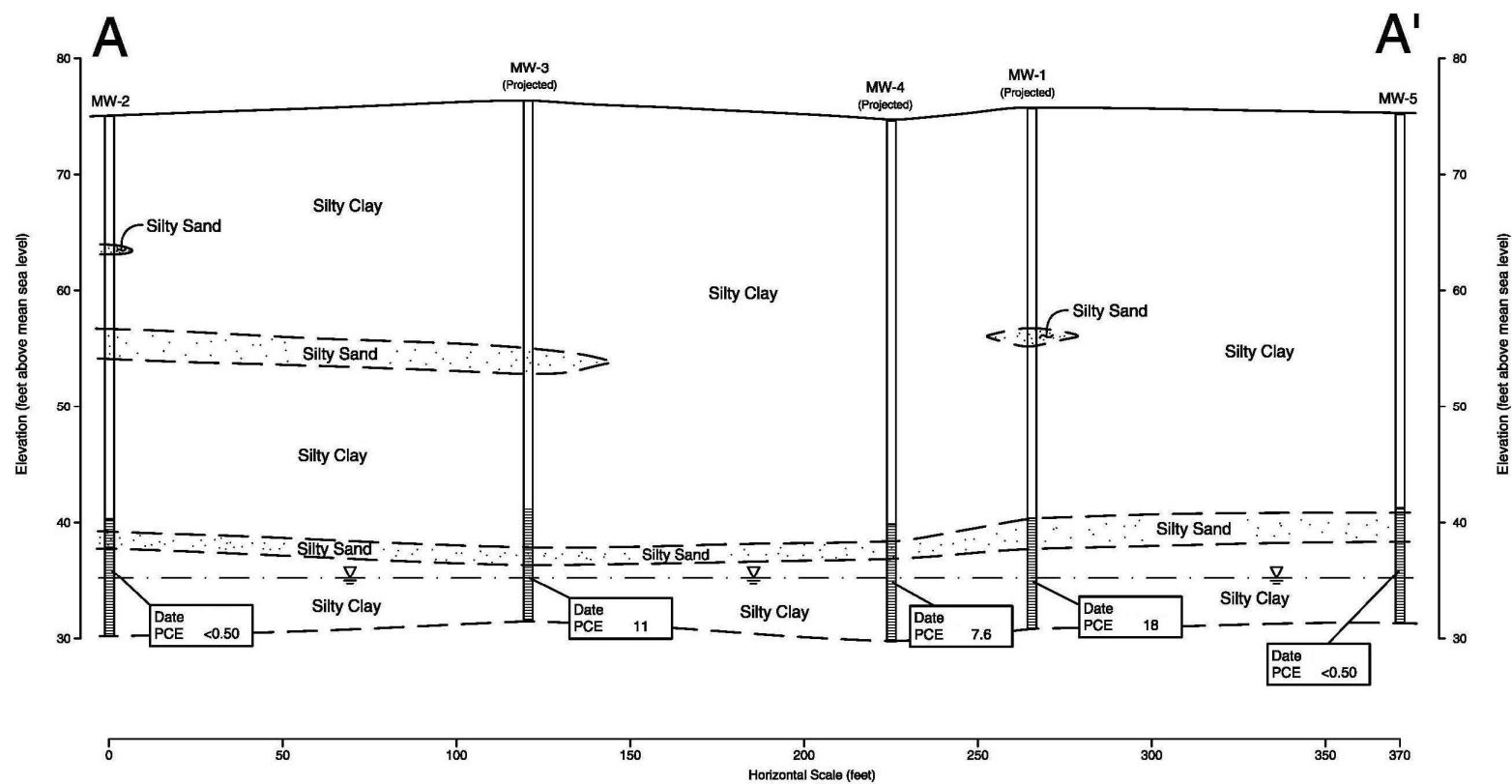
0 60 ft.

CONCEPTUAL SITE MODEL
Iso-Concentration Contour Map

FIGURE

5B





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- Silty Sand
- Silty Clay
- - - Approximate elevation of water table

CONCEPTUAL SITE MODEL
Geologic Cross-Section

FIGURE

5D

TABLE 1 SUMMARY OF SAMPLING LOCATIONS AND RATIONALE

Copy Table 1 from Appendix C – Phase I Addendum.

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APPENDICES

APPENDIX A DTSC PEA DETERMINATION LETTER

If DTSC provided a determination letter that an SSI is required based on review and approval of a PEA Report, it should be provided here and referenced in the text.

APPENDIX B RESPONSES TO DTSC COMMENTS

A response to DTSC comments should be prepared as a table. The table should restate each comment and provide the associated response. Each response should clearly state the proposed revisions and reference the location in the text that will be revised.

APPENDIX C QUALITY ASSURANCE PROJECT PLAN

The Quality Assurance Project Plan should be provided here and referenced in the text.

APPENDIX D HEALTH AND SAFETY PLAN

The Health and Safety Plan should be provided here and referenced in the text.